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EXAMINER

NGUYEN, HA T

ART UNIT

PAPER NUMBER

2812

DATE MAILED: 07/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/981,852

Applicant(s)

MERRICKS ET AL.

Examiner

Ha T. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 May 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Notice to applicant

1. Applicants' Amendment and Response to the Office Action mailed 9-9-02 has been entered and made of record (Paper No. 8).

Response to Amendment

2. Applicants' arguments with regard to the rejections under 35 U.S.C. 102 or 103 have been fully considered, but they are not deemed to be persuasive for at least the following reason. Applicants argued that Cohen (USPN 6136707) does not teach the use of electroplating bath to form a seed layer. The examiner disagreed, note that applicant's arguments are largely directed to what the cited references teach individually. However, it is axiomatic that one cannot show nonobviousness by attacking references individually where the rejection, as here, is based on a combination of references. *In re Young*, 403 F.2d 754, 159 USPQ 725 (CCPA 1968); *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). For example, applicant argues that Cohen does not disclose an electroplating bath containing Cu pyrophosphate as here claimed. However, Mahapatra et al. (USPN 6301399, hereinafter "Mahapatra"), not Cohen, is employed in the rejection to show that feature of the claimed process. In similar manner Applicants argued Mahapatra does not teach the features rejected using Cohen. Cohen discloses substantially all features claimed including forming an enhanced seed layer using a plating solution but does not disclose an electroplating solution containing Cu pyrophosphate, Mahapatra is used to show that missing feature, besides it is well known in the art that electroless plating and electroplating are interchangeable used to form metal on a seed layer (see for examples USPN 4996133 to Brighton et al., 4992847 to Tuckerman, and 6355153 to Uzoh et al.). Therefore the combined teaching of Cohen and Mahapatra does make obvious the inventions of claims 1, 2, 4, 6, 7, 9, and 11-13.

Applicants also argued that Tsai et al. (USPN 6110817, hereinafter "Tsai") does not disclose nor suggest that the PVD seed layer discontinuous, the examiner disagreed. Cohen shows that seed layer deposited by PVD in a narrow openings with large aspect ratios fails to be continuous (see col. 3, lines 34-37), this is applied to the case of Tsai which has an aspect ratio as high as 10 (see col. 3, lines 6-14). Besides, both acidic and alkaline electroplating solutions are

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well known in the art, depending on a specific application, an appropriate solution is used. Therefore the combined teaching of Tsai and Mahapatra does make obvious the limitations of claims 1, 2, 4, 6, 7, 9, and 11-15. In a similar manner the combined teaching of Cohen or Tsai with Mahapatra and Kaneko (USPN 6416571, hereinafter "Kaneko") does make obvious the limitations of claims 3, 5, 8, and 10.

Applicants are referred to the modified rejection given below.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103^(a) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1, 2, 4, 6, 7, 9, and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cohen in view of Mahapatra.

[Claims 1, 6, and 11-13] Referring to Figs. 3 and 4 and related text, Cohen discloses a method of manufacturing an electronic device (inherently an article produced) comprising the step of contacting a metal seed layer having discontinuities 126 disposed on a substrate 112 having one or more apertures having a size of $\leq 1\mu\text{m}$ with a copper electroplating bath, the examiner interprets that when the conformal seed layer 128 is formed by electroless plating, the non-conformal seed layer 126 contacts a copper electroplating bath, the substrate containing one

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or more apertures (see col. 2, line 7- col. 3, line 4), the non conformal seed layer is enhanced by contact with a Cu electroplating composition in the formation of the conformal seed layer; Cohen also discloses a method for removing excess material from a semiconductor wafer containing one or more aperture by using a chemical mechanical planarization process to remove the excess material from the semiconductor wafer; wherein the apertures contain a seed layer deposit covered by an electroplated copper layer (See col. 6, lines 25-44). Cohen also discloses that the process is for semiconductor metallization (see col. 1, lines 6-17). But it does not disclose expressly the details about the composition of the Cu bath, a bath of an alkaline electroplating composition comprising copper pyrophosphate, and the substrate is an integrated circuit device. However, the missing limitations are well known in the art because Mahapatra discloses this feature (See col. 6, lines 20-30). Besides, it is well known in the art the semiconductor structure is formed in an integrated circuit. A person of ordinary skill is motivated to modify Cohen with Mahapatra to obtain plated copper film of desirable characteristics.

[Claims 2 and 7] Mahapatra also discloses wherein the electroplating bath has a pH of from 8 to 9 (see col. 6, lines 29-35); and

[Claims 4 and 9] wherein the electroplating bath further comprises one or more bases selected from ammonium hydroxide of tetra(C1-C4)alkylammonium hydroxide (see col. 6, lines 29-35).

Therefore, it would have been obvious to combine Cohen with Mahapatra to obtain the invention as specified in claims 1, 2, 4, 6, 7, 9, 11-13, 16, and 17.

5. Claims 1, 2, 4, 6, 7, 9, and 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsai in view of Mahapatra.

[Claims 1, 6, and 11-15] Referring to Figs 1-4 and related text, Tsai discloses a method of manufacturing an electronic device (inherently an article produced) comprising the step of contacting a metal seed layer 14 having discontinuities disposed on a substrate having one or more apertures having a size of $\leq 1\mu\text{m}$ with a copper electroplating bath, the substrate containing one or more apertures, the seed layer is enhanced by contact with a Cu electroplating composition (see col. 3, lines 6-47), a seed layer formed by PVD inherently contains discontinuity (see Cohen); Tsai also discloses a method for removing excess material from a

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semiconductor wafer containing one or more aperture by using a chemical mechanical planarization process to remove the excess material from the semiconductor wafer; wherein the apertures contain a seed layer deposit covered by an electroplated copper layer (See col. 4, lines 43-46); subjecting the electroplating bath to sufficient current density to provide a metal seed layer substantially free of discontinuity (see col. 3, line 38-col. 4, line 5), because Tsai uses current density similar to the instant claimed invention, it is inherent that Tsai's process produces the similar Cu characteristics. Tsai also discloses that the process in semiconductor (see col. 1, lines 12-22). But it does not disclose expressly the details about the composition of the Cu bath, a bath of an alkaline electroplating composition comprising copper pyrophosphate, and the substrate is an integrated circuit device. However, the missing limitations are well known in the art because Mahapatra discloses this feature (See col. 6, lines 20-30). Besides, it is well known in the art the semiconductor structure is formed in an integrated circuit. A person of ordinary skill is motivated to modify Tsai with Mahapatra to obtain plated copper film of desirable characteristics.

[Claims 2, 4, 7, and 9] Mahapatra also discloses the limitations of claims 2, 4, 7, and 9, as shown above.

Therefore, it would have been obvious to combine with to obtain the invention as specified in claims 1, 2, 4, 6, 7, 9, and 11-17.

6. Claims 3, 5, 8, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cohen or Tsai in view of Mahapatra and further in view of Kaneko.

The combined teaching of Cohen or Tsai and Mahapatra discloses substantially the limitations of claims 3, 5, 8, and 10, as shown above.

But it does not disclose expressly the use of the use of a complexing agent or a brightener and its amount in the electroplating bath.

However, the missing limitations are well known in the art because Kaneko discloses these features (See col. 1, lines 39- 53 and col. 4, lines 36-42).

A person of ordinary skill is motivated to modify Mahapatra with Kaneko to obtain plated Cu film of desired characteristics . Note that Kaneko discloses that the use of complexing

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agent and/or brightener is conventional in plating, whether it is Cu plating or Cu-Sn plating the teaching still applies because the bath used for Cu-Sn plating contains Cu plating bath.

Therefore, it would have been obvious to combine Cohen or Tsai and Mahapatra with Kaneko to obtain the invention as specified in claims 3, 5, 8, and 10.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (703)308-2706 . The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling, can be reached on (703) 308-3325. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



Ha Nguyen
Primary Examiner

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